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(पहला पुनरीक्षण)

Indian Standard

AUTOMOTIVE VEHICLES — BRAKING SYSTEMS — METHOD OF TEST ON BRAKE DYNAMOMETER FOR TWO AND THREE WHEELERS

(First Revision)

UDC 629·118·3—592 : 620·172·215·1

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NEW DELHI 110002

May 1994 **Price Group 4**

Automotive Braking Systems Sectional Committee, TED 4

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Braking Systems Sectional Committee had been approved by the Transport Engineering Division Council.

This revision is undertaken to align this standard with the latest amendments issued to IS 10376 : 1982, IS 11716 : 1986 and also to IS 13670 : 1992 that covers three wheelers whose recommended mass is less than 1 000 kg.

The committee responsible for the preparation of this standard is given in Annex A.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

AMENDMENT NO. 1 SEPTEMBER 1997
TO
IS 13453 : 1994 AUTOMOTIVE VEHICLES — BRAKING SYSTEMS — METHOD OF TEST ON BRAKE DYNAMOMETER FOR TWO AND THREE WHEELERS

(First Revision)

(*Page* 3, *clause* 5.3.1) — Substitute the following formula for the existing formula:

$$n_c = \sqrt{W/W_c} \times n$$

(*Page* 3, *clause* 7.2.3) — Substitute the following formula for the existing formula:

$$t = \frac{30\,000}{\pi R n}$$

(TED 4)

Reprography Unit, BIS, New Delhi, India

Indian Standard

AUTOMOTIVE VEHICLES – BRAKING SYSTEMS – METHOD OF TEST ON BRAKE DYNAMOMETER FOR TWO AND THREE WHEELERS

(First Revision)

1 SCOPE

This standard covers method of test on brake dynamometer for two and three wheelers such as mopeds, scooters, motorcycles and three wheeled motor vehicles with maximum recommended mass not exceeding 1 000 kg, fitted with drum or disc brakes.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
10376 : 1982	Automotive vehicles — Braking systems — Performance requirements for mopeds
11716 : 1986	Automotive vehicles — Braking systems — Performance requirements for scooters and motorcycles
11852 (Part 1) : 1987	Recommendations for brakes and braking systems for automotive vehicles: Part 1 Terminology
13670 : 1992	Automotive vehicles — Three wheelers — Brake performance requirements

3 TYPE OF TESTS

The following type tests shall be carried out on dynamometer to assess brake performance:

a) Type D_1 test (Performance test),

b) Type D_2 test (Fade test), and

c) Type D_3 test (Wet/dry test) (Applicable for two wheelers only).

4 REQUIREMENTS OF BRAKE DYNAMOMETER

4.1 The brake dynamometer shall be capable of adjustments to the inertia settings specified below:

The inertia setting for the front and rear wheel shall be obtained by the formula:

$$I = \frac{WR^2}{g} \times \frac{1}{N}$$

where

I = Inertia in kg.m.s²;

W = The mass of vehicle to be simulated, in kg (*see* Table 1);

R = Static load radius of type of the wheel where the brake under test is normally fitted, in metres;

g = Acceleration due to gravity (9·81 m/s²); and

N = Number of brakes normally fitted on the wheel.

NOTES

1 While calculating the inertia, the resultant value shall be rounded to the nearest 0·25 kg.m.s².

2 If inertia of dynamometer is set in steps, the set inertia shall correspond to the mass to be simulated within $^{+25}_{-0}$ kgs.

If the same mass of set inertia does not correspond to the exact mass to be simulated, the dynamometer speed shall be as per 5.3.1.

4.2 The brake dynamometer shall be capable of achieving stability to ensure an accuracy of ± 1 percent, of the test speeds, as given in Table 2.

The test speed shall be measured as the number of revolutions of the dynamometer shaft which corresponds to vehicle speed, considering static load radius.

4.3 The braking device shall be installed on the brake dynamometer in such a manner as to represent actual installation on the vehicle on which it is normally fitted.

Table 1 Mass to be Simulated on Dynamometer

(*Clause* 4·1)

Sl No.	Type of Vehicle	Mass of the Vehicle
(1)	(2)	(3)
1	Two wheelers	Maximum recommended mass
2	Three wheelers with independent brake control system	
	a) For brakes acting on the wheel of the axle/axis fitted with one wheel	Maximum recommended mass
	b) For brakes acting on the wheel of the axle/axis fitted with two wheels	Half of the maximum recommended mass
3	Three wheelers with single control system	
	a) For service brake tests	One third of maximum recommended mass
	b) For residual performance (that is, with one system failure)	
	i) Brakes acting on single wheel	Maximum recommended mass
	ii) Brakes acting on two wheels	Half of the maximum recommended mass

Table 2 Test Speeds on Dynamometer for Type D_1 Test

[*Clauses* 4.2, 7.2.1, 7.2.4, 8.1 *and* 8.3.3(b)]

Sl No.	Type of Vehicle	Speed (km/h)
(1)	(2)	(3)
1	Two wheelers with engine capacity not exceeding 50 cc	30 km/h or 60% of declared maximum speed of vehicle whichever is lower
2	Two wheelers with engine capacity exceeding 50 cc	50 km/h or 60% of declared maximum speed of vehicle whichever is lower
3	Three wheelers with maximum recommended mass not exceeding 1 000 kg and engine capacity not exceeding 50 cc	30 km/h or 80% of declared maximum speed of vehicle whichever is lower
4	Three wheelers with maximum recommended mass not exceeding 1 000 kg and engine capacity exceeding 50 cc	40 km/h or 80% of declared maximum speed of vehicle whichever is lower

4.4 The brake actuating force applied on the dynamometer shall be adjusted to the values calculated as per the design of linkage of vehicle to correspond to the control force at actuating levers/pedals specified in Table 3.

Table 3 Maximum Recommended Control Force at Actuating Levers/Pedals on Vehicle

(*Clause* 4.4)

Sl No.	Type of Vehicle	Recommended Control Force for	
		Hand operated control	Foot operated control
(1)	(2)	(3)	(4)
1	Two wheelers	260 N (26 kg)	330 N (33 kg)
2	Three wheelers with maximum recommended mass not exceeding 1 000 kg	260 N (26 kg)	500 N (50 kg)

4.5 Alternatively, tests may be carried out on the test track with the control force recorded during vehicle test provided that:

a) This force is less than that given in Table 3.

b) The brake performance test on the vehicle shall comply with the requirements for the class of vehicle, such as mopeds, scooters, motorcycles or three wheelers as applicable (*see* **3**).

4.6 The dynamometer shall have a blower which may supply air for cooling the braking system. This shall be sufficient to maintain the temperature of brake lining (measured as prescribed in **5.2**) nearly constant and in any case less than 100°C.

5 GENERAL TEST CONDITIONS

5.1 The brake dynamometer shall be brought to the specified speed at which the test is to be carried out; when the period of stabilization has been achieved (normally 5 seconds) with the clutch disengaged, the brake shall be applied till the shaft comes to rest.

5.2 During type D_1 and other performance tests, the brakes shall be cold at the beginning of brake application. The temperature of lining shall be measured by a thermocouple mounted on the leading shoe below the rubbing surface at a distance of not more than one mm and as close to centre of brake lining area as possible. The brakes shall be deemed to be cold if the temperature thus measured is less than 100°C.

5.3 Speed

The speed of the dynamometer shall be obtained from the following equation:

$$n = \frac{V}{0{\cdot}12\,\pi R}$$

where

V = Initial speed in km/h;

R = Static load radius of the tyre of the wheel, which is fitted with the brake under test, in metres;

n = Speed of the dynamometer shaft in number of revolutions per minute immediately before start of the braking.

5.3.1 If the inertia on the dynamometer is not set to the exact value corresponding to the required vehicle mass condition, the speed shall be calculated by the following formula.

$$n_0 = \sqrt{W/W_0} \times n$$

where

n_c = the corrected dynamometer speed in rev/min;

n = the speed calculated as per **5.3**;

W = the mass to be simulated, kg; and

W_c = the mass corresponding to the set inertia, kg.

5.4 The brake performance may be established by measuring the braking torque.

5.4.1 The braking torque may be measured by a suitable torque transducer or load transducer. In case of mechanically operated brakes, care shall be taken that the actuating force does not influence the measured torque or proper correction shall be applied.

5.5 The bedding in of the brakes and the adjustment of brake shoe clearance at the beginning of the test shall be as per the vehicle manufacturer's recommendations.

5.6 During the series of testing, brake adjustment shall not be carried out.

6 TYPE D_1 TEST

6.1 Type D_1 test shall be carried out under the condition for inertia, speed or actuating force as specified in **4.1**, **4.2** and **4.4** respectively.

6.2 The brake performance shall be the arithmetic average of four valid readings. The readings shall be considered valid if they do not differ from the arithmetic average by more than 1·5 percent.

6.3 Before start of each test the brake shall be cold. The blower that supplies air for cooling the braking system shall be switched on to keep the temperature within limits.

7 TYPE D_2 TEST

Type D_2 test shall be carried out in three sequences:

a) Type D_1 test with brakes cold,

b) A series of repeated brake applications, and

c) A single D_1 test immediately after the last stoppage of the repeated stoppages.

7.1 Type D_1 Test with the Brakes Cold

This test shall be carried out in the manner specified in **6**. If for evaluating the brake performance, this test has been conducted prior to D_2 test, the same readings may be used.

7.2 Repeated Stoppages

A series of ten stoppages shall be carried out in accordance with the requirements specified in **7.2.1** to **7.2.6**.

7.2.1 In case of three wheelers, the test speed shall be 70 percent of maximum design speed of the vehicle and for two wheelers the values shall comply to those specified in Table 2.

7.2.2 The brakes shall be cold at the initiation of the first stoppage.

7.2.3 The time elapsing between the successive stoppages shall be that corresponding to the to the equivalent distance of 1 000 m and this may be calculated by the following formula:

$$t = \frac{30\,000}{2\,\pi\,R\,n}$$

where

t = Time elapsed between successive stoppages, in seconds;

R = Static load radius of tyre of the wheel where the brake under test is normally fitted, in metres; and

n = Speed of the inertia dynamometer (calculated as per **5.3** or **5.3.1** as applicable) in rev/min.

7.2.4 The actuating force shall be that corresponding to a braking torque to achieve a deceleration of 3 m/s², with the brakes cold, or those specified in Table ?, whichever is lower.

This force shall be established with the brakes in cold condition and shall be maintained constant for all the ten repeated stoppages.

NOTE — For the purpose of dynamometer testing the engine braking effect shall be considered as negligible.

7.2.5 During all the repeated stoppages, the blower that supplies air for cooling the braking system shall be switched off.

7.2.6 After each stoppage, the dynamometer shall be accelerated to the test speed and shall be maintained at that speed till initiation of next stoppage.

7.3 Hot Performance Test

Immediately after the ten repeated stoppages, the brake performance shall be measured as per the procedure given for type D_1 test. The actuating force shall be kept the same as that used for type D_1 test as per **7.1**.

The hot performance test shall be carried out only once.

8 TYPE D_8 TEST

Type D_8 test is applicable for two wheelers only.

8.1 The initial speed shall be as per Table 2.

8.2 The control force shall be that required to achieve a braking torque corresponding to deceleration of one m/s^2 for front brakes and 2·2 m/s^2 for rear brakes, when the linings are dry and cold.

8.3 Wetting Process

8.3.1 The wetting ingredient shall be, preferably tap water at a temperature not exceeding 30°C and the soaking time shall be 15 minutes.

8.3.2 The water shall be applied on the brakes as follows:

a) In the case of exposed disc brakes, equal amount of water shall fall on both sides of the disc evenly distributed across the face of the disc swept by the friction pad and not greater than one quarter of a revolution in advance of the friction pads.

b) In the case of fully or partly enclosed disc brakes, equal amounts of water shall fall on both sides of the shield and one quarter of a revolution in advance of the friction pads.

c) For drum brakes, the prescribed amount of water shall be sprayed equally on either sides of drum brake unit (on the stationary back plate and on rotating drum) from nozzles so positioned as to be two thirds of distance from outer circumference of rotating drum to the wheel hub, provided always that no nozzle shall be within 15° of, or coincident with a ventillation or inspection port.

d) The test equipment shall allow for continuous wetting of the brakes to be tested for each test run at a flow rate of 15 litres per hour.

NOTE — Two disc brakes on one wheel shall be considered as two separate brakes.

8.3.3 To ensure correct wetting of the brakes during the type D_8 tests, the dynamometer shall be driven continuously for the specified period of 15 minutes:

a) With the test equipment in continuous operation according to **8.3.2**;

b) At the speed appropriate to the test as per Table 2;

c) Without the operation of the brakes to be tested; and

d) For a time equivalent to distance not less than 500 m prior to the instant at which the test is to commence.

8.3.4 A schematic diagram of the wetting equipment is given in Fig. 1, 2 and 3.

8.4 Wet Performance or Recovery Tests

8.4.1 The brake performance shall be measured similar to Type D_1 test with actuating force as per **8.2**.

8.4.2 15 stoppages shall be conducted at intervals of two minutes. In case 30 percent recovery has been achieved before the fifteenth stoppage, further recovery stoppages need not be carried out.

For drum brakes, as an alternative, immediately after carrying out the wetting operation as per **8.3**, but within five minutes, the brakes shall be dismantled. If no water is present within the brake, inside the brake drum, inside the stationary brake plate or on any of the brake shoes, no further testing is required. If this alternative method is used it shall be recorded in the test report. If traces of water is found on the brake, the complete type D_8 test shall be repeated.

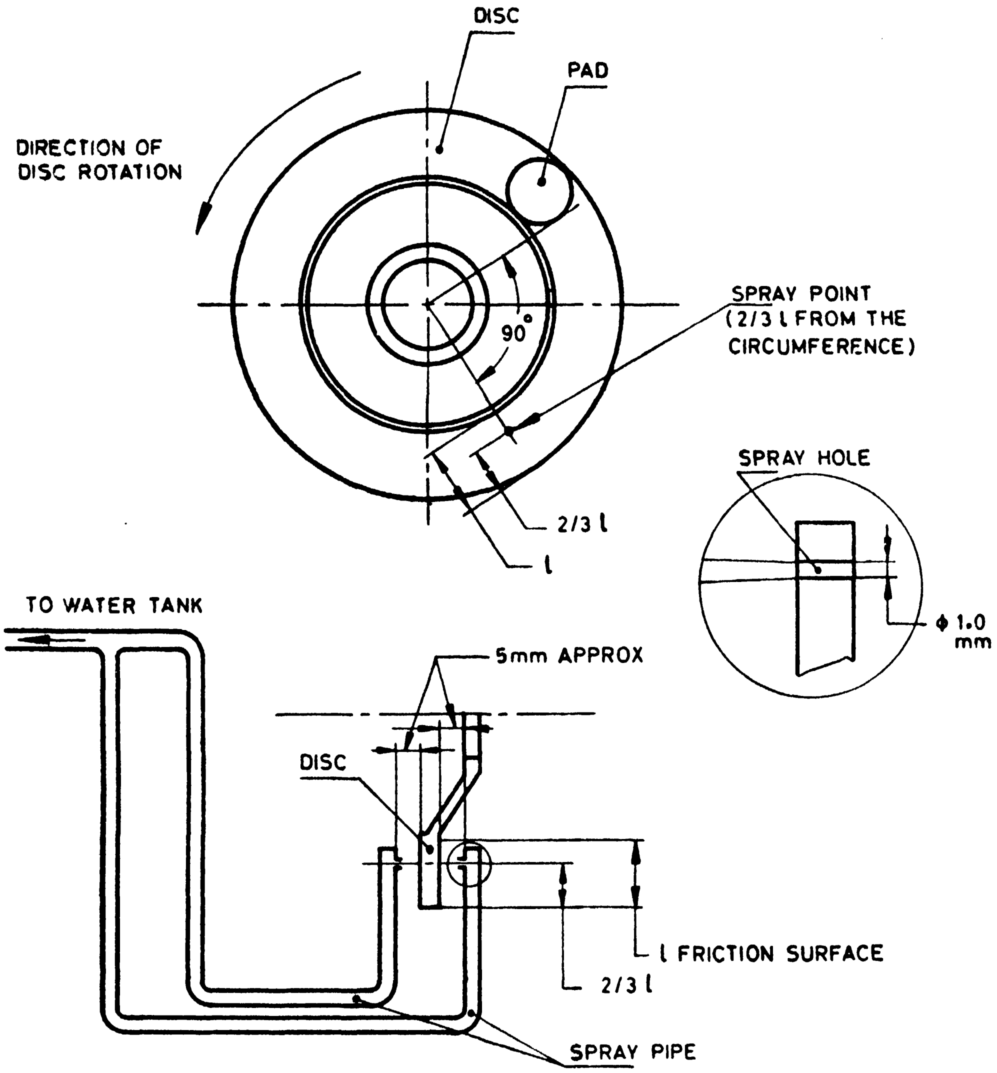


FIG. 1 METHOD OF WATER APPLICATION FOR TYPE D_3 TEST

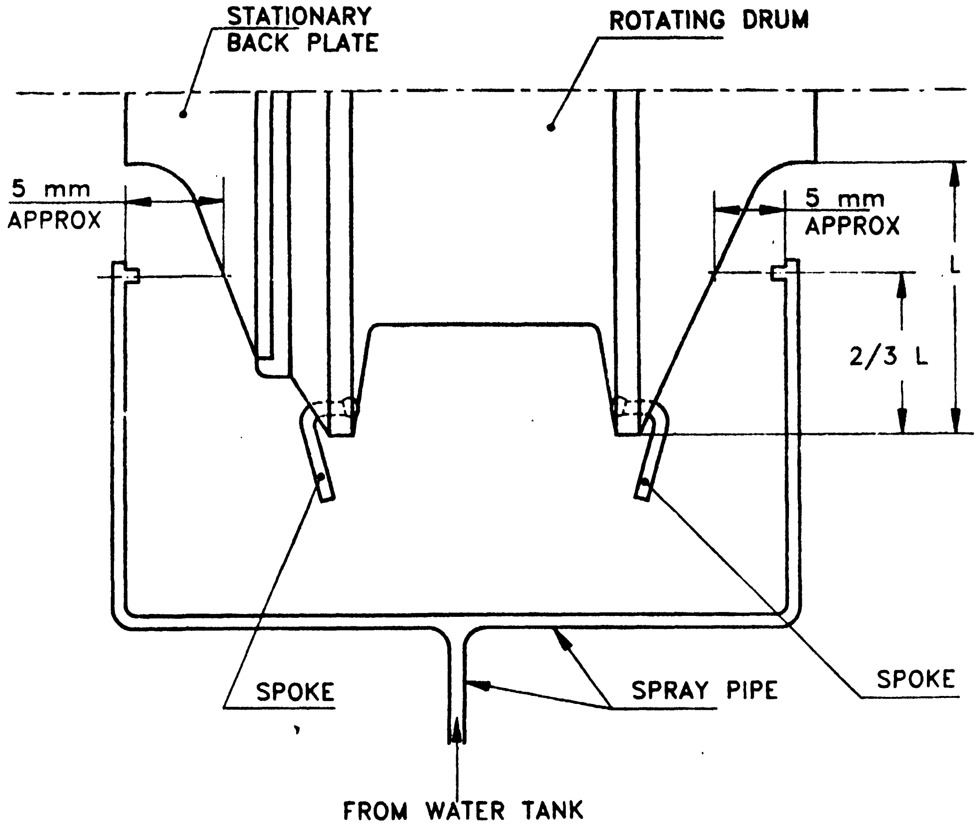
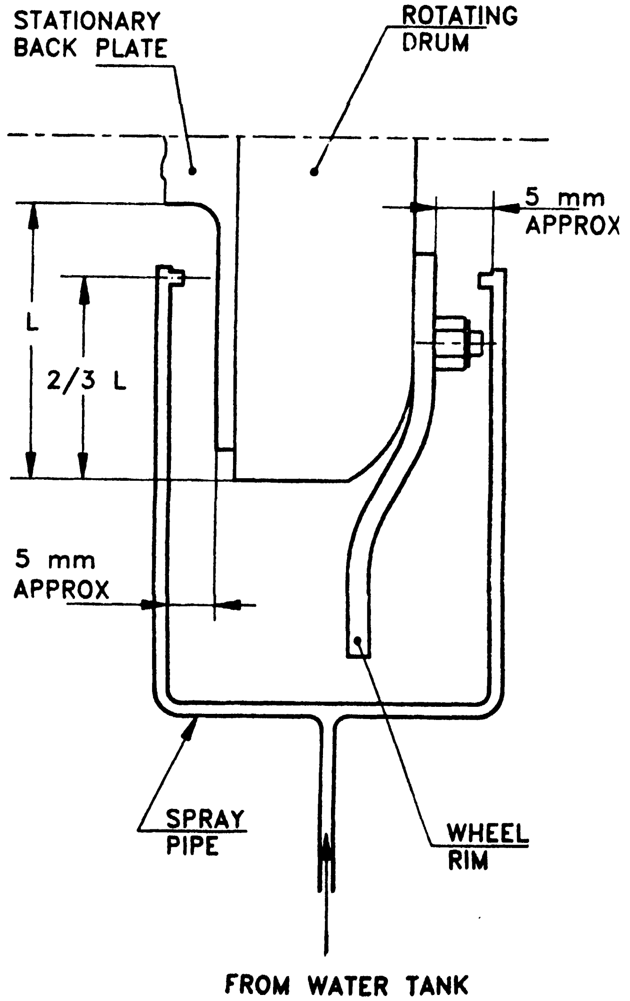


FIG. 2 METHOD OF WATER APPLICATION FOR TYPE D_8 TEST (SPOKE TYPE WHEEL)



ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Composition of Automotive Braking Systems Sectional Committee, TED 4

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Shri V. S. Venkatesan Shri K. N. Balaji (*Alternate*)	Brakes India Ltd, Madras
Shri N. S. Vijayaraghavan Director (Transport Engineering)	Director General, BIS (*Ex-officio Member*)

Member Secretary

Shri M. V. S. D. Prasada Rao
Deputy Director (Transport Engineering), BIS

(*Continued on page* 8)

(*Continued from page* 7)

Two and Three Wheelers Braking Systems Subcommittee, TED 4 : 1

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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